Gemini Planet Imager

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The next major step on the road to space-based detection of terrestrial planets is direct imaging of a significant population of giant planets. With recent advances in high-order adaptive optics, careful system design, and advanced coronagraphy, it is possible for an AO system on a ground-based 8-m class telescope to achieve contrast levels of 10-7 to 10-8, sufficient to detect warm self-luminous Jovian planets in the solar neighborhood. Such direct detection is sensitive to planets inaccessible to current radial-velocity surveys and allows spectral characterization of the planets, shedding light on planet formation and the structure of other solar systems. We have begun the construction of such a system for the Gemini Observatory. Dubbed the Gemini Planet Imager (GPI), this facility-class instrument will be deployed in 2010 on the Gemini South telescope. It combines a 2000-actuator MEMS-based AO system, an apodized-pupil Lyot coronagraph, a precision infrared interferometer for real-time wavefront calibration and control of systematic errors at the nanometer level, and a infrared integral field spectrograph for detection and characterization of the target planets. GPI will be able to achieve Strehl ratios over 0.9 at 1.65 microns and to observe a broad sample of science targets with I band magnitudes less than 9. I present here an overview of the GPI instrument design and an error budget highlighting key technological challenges. I will discuss the similarities and differences between ground-based and space-based coronagraphy and briefly discuss future AO capabilities on 30-m-class extremely large telesopes.